Water for irrigating the land is developed from natural mountain water and by three separate pumping systems. Of the planted area 2500 acres are irrigated by water supplied from the pumping systems and 1500 acres from mountain supply. The system of cultivation is irrigation and fertilization using about 800 pounds of high-grade fertilizer and 200 pounds nitrate of soda to the acre. For the 1903 crop, which is now being planted, there will be 85 per cent plant and 15 per cent of rattoons. The 1901 crop was from 2000 acres, realizing in the mill 6568 tons of raw sugar. The estimated crop for 1902 is 10,000 tons of raw sugar from 1700 acres, while the 1903 crop is estimated at about 15,000 tons of sugar from 2100 acres.

The method of conveying cane from field to mill is by railroads and V flumes, stations being established where necessary; the cane is conveyed by flumes direct into the cars and thence conveyed to the mill. The length of the main trackage upon the plantation is about twenty-five miles, which is supplied with 300 cane cars, having an average capacity for holding three tons, which are transported to the mill with engines of sufficient horsepower.

At the mill the cane is delivered from the cars to the endless carrier by the aid of the Gregg automatic cane car unloader, which is supplied with four sets of sprocket chains and steel teeth instead of the regulation style of two sets. From the cane carrier the cane passes to a Krajewski crusher, from whence it passes through a modern triple 3-roller mill (9-roller mill), capacity 125 tons in twenty-four hours, or between sixty and seventy tons of raw sugar in a day of twelve hours.

From the mill the bagasse is conveyed automatically to the furnace room and dropped directly to the Risdon automatic furnace feeders. The mill is practically a new structure and was built by the Honolulu Iron Works, and is supplied with the most modern appliances for manufacturing raw sugar, such as juice strainers and elevators, Deming super-heating apparatus, bog filters, settling tanks, Little effect, one Honolulu and two German vacuum pans, twenty-five Hepworth centrifugals driven by separate power, six filter presses and much other machinery. The management is now erecting a sugar elevator conveying the sugar from the centrifugals to a higher floor, from whence it is dropped down to the bags. By this method all shoveling of the sugar into sacks is dispensed with, and the sugar given an opportunity to cool off before being sacked.

Two grades of sugar are manufactured and known as A and B; all other grades are returned and worked over again into the above two grades. Water for general mill use is obtained from wells sunk upon the mill site, over which have been erected two 3,000,000-gallon Worthington pumps. All water emanating at and not required in the mill goes into the irrigation system, and is utilized to irrigate a large area of cane below the 80-foot level. Maceration of from 12 to 15 per cent is carried on in the mill by utilizing the condensation waters from the triple-effect.

The average yield of all cane product put through the mill is approximately seven tons of raw sugar to the acre, or forty-nine tons of raw sugar to the acre, or fifty-six extraction of sucrose in cane for the season of 1901 was 93 per cent, the juice in the cane standing high, more especially in stony lands. From the mill the sacked sugar is conveyed in trainload lots to the plantation shipping point at Kaanapali, where have been erected the necessary appliances in the way of cranes and lighters for handling the sugar into the holds of the vessels, by which it is conveyed to New York and the Pacific Coast. Here also have been erected two large warehouses having a storage capacity of 20,000 sacks respectively.

At the present time the manager is figuring to utilize the natural water pressure from the mountains for the purpose of generating electricity to operate the various pumping plants upon the plantation, and thus effect a large saving in coal consumption. At the present time about 1000 men are employed upon the plantation, about one-half of whom are contractors or company men.

Among the many improvements made the most important and farthest-reaching in its beneficial effects for the plantation is the reservoir system, where can be stored millions of gallons of water. At the present time there are eight individual reservoirs, five in Kaanapali and three in Lahaina, having a joint capacity for storing 65,000,000 gallons. It is the intention of the management to extend the reservoir system and construct a number of very large storage capacity for the purpose of conserving the storm freshet waters.

A still further improvement is the extension of the plantation railroad system, covering the entire plantation fields at Lahaina and Kaanapali up to an elevation of 700 feet.

The manager of this vast and well-kept plantation is Mr. Barkhausen, who has filled that position since December 1, 1900, previous to which time he was manager at Kipahulu for a period of two years. Following is the list of officers of the Pioneer Mill Company:

Paul Isenberg, President.
H. A. Isenberg, Vice President.
H. Schultze, Treasurer.
F. Klamp, Secretary.
W. Pfotenhauer, Auditor.

The first four officers, together with F. W. Macfarlane, J. A. McCandless and H. Focke, comprise the Board of Directors.

Favorable legislation in connection with the labor question of the Hawaiian Islands means millions to the sugar industry and a consequent increased prosperity for the entire Islands.

Haiku Sugar Co.

The Haiku Sugar Company property forms one of the important plantations on the Island of Maui and comprises a large area of land adapted to the successful growing of sugar cane. In the Hamakuapoko proper portion of the plantation there are available for cane 3224 acres of land. In the Kaluanui or old East Maui plantation portion 1242 acres are available. In the Haiku portion (now used for pasturage) about 2000 acres are available. In addition to the foregoing the company has about 5000 acres of pasturage and 4000 acres of forest lands. The forest land is an undivided interest in forest reservations owned in conjunction with Paia plantation and Hawaiian Commercial & Sugar Co. The water supply of the plantation is quite extensive, and consists of a nine-twentieths interest in the Hamakua ditch, which gives the company, when the ditch is full, 10,500,000 gallons in twenty-four hours, the remaining eleven-twentieths being owned by the Paia plantation. The company also has a share in the Hawaiian Commercial & Sugar Co.'s ditch, which furnishes 3,000,000 gallons in twenty-four hours. In addition to the foregoing supply the company have erected two Reidler pumping plants, one with a capacity of 5,500,000 gallons, delivered at an elevation of 450 feet and one with a capacity of 3,000,000 gallons delivered at an elevation of 250 feet. Besides the above there have been constructed several reservoirs for catching the surplus from the ditch system in winter, having a joint capacity for holding 60,000,000 gallons. The company also has had in view for some time the construction of additional storage reservoirs at Haiku and Kaluanui, covering an area of seventy-six acres and having a storage capacity of 315,000,000 gallons of water, or a supply sufficient to irrigate 1000 acres for fully a month. The outlet of this reservoir system would be at an altitude of 450 feet above the level of the sea, and would thus make the supply available for nearly 2000 acres at Hamakuapoko and approximately 1000 acres at Haiku.

The principal varieties of cane grown are the Lahaina, Rose Bamboo and Yellow Caledonia, all of which, as will be seen, is under a system of irrigation. The total sugar output of the mill, for the season of 1901, was 5480 tons, which output will, it is anticipated, be largely increased for the 1902 crop. For the coming crop there is 750 acres of plant and 550 acres of rattoon canes, and should the purity of the sucrose stand high the coming or 1902 season's output should reach nearly 7000 tons of raw sugar.

Many improvements have been made in and about the plantation and others are in contemplation.

Upon the plantation has been erected a nine-roller mill having a daily output of forty tons of raw sugar. In the manufacture of sugar there have been introduced into the mill all the mechanical appliances necessary, consisting of boiling and evaporating machinery, improved centrifugals with a sugar conveyor and elevator. The sugar-boiling capacity has been increased by enlarging one of the vacuum pans, all of which renders the operation of the mill more satisfactory.

Steam is the motive power for driving the machinery, which is generated by utilizing the bagasse from the mill for fuel. The railway system connecting up the various cane fields with the mill has been improved by changing the same from a two-foot to a three-foot gauge, thus conforming with the trackage on the Paia, Spreckelsville and Kihei plantations, and likewise the Kahului Railroad system. A large number of additional cane cars have been purchased. At the mill an endless cane carrier has been installed, and a Gregg cane car unloader, which greatly facilitates the unloading of the cane cars.

At the present time there are 574 men employed upon the plantation, which includes skilled and unskilled labor. In the preparation of the soil for planting Fowler's steam tackles are largely in use, although considerable land in places is turned over by the ordinary system of plowing with mules and horses, quite a number of which are kept upon the plantation.

Ordinary dirt roads traverse the property to the extent of several miles through the cane fields, which are made use of in expediting the handling of supplies, etc.

H. A. Baldwin is the manager of this plantation, while the following list constitutes the officers for the present year:

H. P. Baldwin, President.
S. M. Damon, Vice President.
J. P. Cooke, Treasurer.
J. B. Atherton, Secretary.
W. G. Taylor, Auditor.
T. H. Hogan, Director.

Paia Plantation.

Located ten miles from Wailuku and in the same district as the Haiku and Hawaiian Commercial & Sugar plantations, are situated the properties of the Paia plantation, sugar, which came off about 800 acres of land, 6000 of which area is considered well adapted for the successful production of sugar cane, the balance being pasture and farm land.

The first cane planted upon these lands was years ago, and consisted entirely of the Lahaina variety. The crop for 1901 will realize in the mill some 7600 tons of raw sugar, of which area about 800 acres were plant cane, and 500 or 600 acres of long rattoons. For the 1902 crop the sugar output will be from 1350 acres, which is about the same area as the 1901 crop. Lahaina cane is the principal variety grown upon the plantation, although some Rose Bamboo is likewise grown.

The method of conveying the ripened cane to the mill is by V flumes, cars and wagons. This year one-third of the product was flumed, the balance being hauled by wagons and cars.

The entire area planted to cane is under a system of irrigation, about one-half of which lies above the pumping range, and is irrigated by the Hamakua Ditch Company, practically controlled by the Haiku and Paia plantations.

Three pumping plants have been installed, having a joint capacity of fully 15,000,000 gallons and covering all the cane lands up to an elevation of 410 feet, which is about one-half the area now in cane. Two Fraser and Chalmers pumping plants, with a joint capacity of 10,000,000 gallons, have been erected, in addition to which is a 5,000,000 and a 1,000,000-gallon Blake pumping plant.

The cane as it arrives at the mill from cars and wagons is fed to the cane carrier by the aid of the Gregg automatic cane unloader, from whence it is conveyed to a 34x66 nine-roller mill, the three-roller mills being subjected to the following hydraulic pressure: No. 1 mill, 275 tons; No. 2 mill, 351 tons; No. 3 mill, 376 tons.

The mill is supplied with a super-heating clarification system, settling tanks, 10,000 gallon capacity, triple effect, one 10-foot Honolulu Iron Works and one 8-foot Robert Deely vacuum pans, twelve 30-inch centrifugals driven by separate engines, seven filter presses having 3000 square feet of filtering surface, and much other machinery found necessary. The motive power of the mill is steam, which is generated by the use of the bagasse from the mill, which is conveyed automatically to the furnace room.

The capacity of the mill under favorable conditions of the cane and delivery of same at mill, is sixty tons of raw sugar in twenty-four hours, although at the present time the average output is fifty tons. According to the books of the chemist, the mill extraction is 81.89 on weight of cane, and 92.88 on sucrose in cane. The plantation is equipped with 160 cane cars, which have an average capacity of from three and one-half to five tons, the cars being twelve feet in length, six feet in width and made of malleable iron with steel wheels, and weighing 2000 pounds. These cars are made by Gregg & Co. of Cleveland, Ohio, who have turned out nearly a thousand of them on Maui alone, and who also manufacture the Gregg cane unloader. A General Electric incandescent electric lighting system has been installed in the mill, which is operated by a marine type of engine. Large new blacksmith and machine shops have been erected and are operated by independent power.

In addition to the plantation the company own the Grove ranch, where some 1000 head of cattle and 200 head of horses are maintained. The raw sugar, when sacked and ready for shipment, is conveyed by cars direct from the sugar room to warehouses at Paia railway station, from whence it is shipped to Kahului, which is the principal shipping port of the Island of Maui.

Upon the above plantation is about five miles of permanent trackage, which includes the mill track. The new line, which was built in 1900-01, is now in operation, and is used to transport cane to the mill from the lands in the Paia district, reaching from 175 feet elevation at the mill to an altitude of 420 feet. In construction of the road, 35-pound steel rails were used, and it is the intention to extend the system so as to have permanent lines over the entire plantation. In addition to the permanent trackage, the Paia, like all other plantations, carries more or less portable tracks.

The hauling of cars to mill is performed by an 18-ton Porter engine.

Following is the list of officers of the Paia plantation:

H. P. Baldwin, President.
S. M. Damon, Vice President.
J. P. Cooke, Treasurer.
J. B. Atherton, Secretary.
W. G. Taylor, Auditor.

Wailuku Sugar Co.

Located on the Island of Maui and in the district of Wailuku are the plantation properties of the Wailuku Sugar Company, which practically controls an acreage approximately of 13,545 acres of cane, taro, pasture and forest lands. Of this total area 4457 acres are capable of being planted in cane, while the area in cane at the present time is 2566 acres.

The first cane planted upon the lands in question was thirty-one years ago, and consisted entirely of the Mountain and Lahaina varieties. The lowest elevation that cane is planted is thirty feet and the highest 1000 feet. The character of the soil is a black, heavy loam on the uplands, the soil being slightly sandy on the lowlands. The season for planting is from June to the middle of September, it being advantageous that planting shall have been performed within the above period. The 1902 and 1903 crop will be from 1308 acres, of which area 230 acres had been planted up to August 1st, there being included in this total area 239 acres of rattoons.

In the cultivation of the soil, about 800 pounds of high-grade fertilizer is used to the acre, while the soil is plowed to a depth of from fourteen to sixteen inches, by means of one set of "Fowler's steam tackle" as likewise the ordinary methods of mule and horse plowing. At present the entire area in cane is planted with the Lahaina variety, which takes eighteen months in which to mature ready for grinding in the mill.

Irrigation is carried on altogether upon this plantation, the water supply being obtained from the West Maui mountains by means of tunneling and from the natural streams heading in the above ranges. The method of transporting cane from field to mill is by V flumes and railroads. Upon the plantation there are six miles of locomotive track, in addition to which there are some three miles of portable track connecting the various fields with the main trackage system. There are 140 cane cars with an average carrying capacity of from two and one-half to three tons, requiring two Baldwin locomotives in transporting loaded cane cars to the mill.

In addition to the above there are some ten or fifteen miles of dirt road in and about the plantation, which greatly expedites the movement of men and material to any given point. The necessity for adopting a thorough irrigation system can be fully appreciated when the average annual rainfall is known as only twenty-three inches. The plantation lands are fully seven miles in length with an average width of two and one-half miles, and lie in unbroken fields of great size and extent.

At the present time the company has employed some 500 day laborers, contractors and mechanics, while there are maintained upon the plantation 220 head of horses and mules and about thirty head of bullocks.

The cane as it comes to the mill by V flumes or railroads is dropped directly to the endless cane carrier to a Krajewski crusher, and thence on through three 2-roller mills supplied with juice strainers and elevators. The mill is in good shape and supplied with two vacuum pans, triple-effect, settling tanks, ten centrifugals run by separate engine, super-heating clarification system, etc. Adjoining the mill is the molasses house, where have been installed three redwood tanks having an individual capacity of 700 tons.

In the mill maceration from 14 to 22 per cent is carried on by using the condensation waters from the triple-effect. In addition to the above machinery there are five filter presses and other mechanical appliances such as are in general use in all mills. Power to drive the mill machinery is derived through the agency of a Putnam engine of large horsepower rating. An electric lighting plant of the General Electric make has been installed. The entire mill plant was designed and erected by the Honolulu Iron Works.

For the grinding season of 1901 the average daily sugar output of the mill was forty-five tons. The sugar, when sacked and ready for shipment, is conveyed to the port of Kahukului for shipment to New York as well as to San Francisco.

C. B. Wells is the general manager of the plantation. W. G. Ogg is the assistant manager, while the following are the officers:

S. C. Allen, President.
W. F. Allen, Vice President.
G. H. Robertson, Treasurer.
E. F. Bishop, Secretary.
T. R. Robinson, Auditor.

The above officers with M. P. Robinson constitute the Board of Directors.

The mill yield for 1901 will be 4500 tons.

Maui Sugar Co., Ltd.

The Maui Sugar Company, Limited, a small but promising property, is located in the Huelo district on the Island of Maui, and comprises 2500 acres held in fee simple, of which area about 2000 acres are considered to be adapted for growing of sugar cane, the balance being pasture and forest lands. In addition to this the company is negotiating for other lands, which will largely increase the present area of cane lands.

At the present time the company has planted some 900 acres, the principal variety grown being Lahaina, although there is some little Yellow Caledonia. The lowest elevation that cane is planted is 300 feet, while the greatest altitude is 1000 feet. A feature of this property is the natural water supply, which emanates from the Huelo, Olawa, Mokupapa and Waipio gulches and canyons, as likewise constant rains. From these sources the water is led down to the plantation for irrigating purposes by a system of ditches.

At present the ordinary method of plowing with mules is in vogue, but the company is negotiating for the Fowler steam tackle. At present the company is employing between 150 and 200 men, which number will be somewhat increased when the cane harvesting begins.

In the plowing and planting of cane and hauling of supplies and material thirty-six horses and mules and 134 head of working cattle are necessary, while twenty more head of mules are now on the way from the Mainland.

About the first of the year there are approximately 500 acres of cane to come off, which will be ground in the mill now in course of erection, it being estimated that the entire acreage runs between six and seven tons of sugar to the acre. At present the company does not fertilize, but it is the intention to do so within a short time.

The new mill, now in course of construction, was designed and built by the Risdon Iron Works of San Francisco, and is being erected by the company under the management of F. B. Duff. The mill, while one of small capacity, will be most compact and complete in every detail, and contain the very latest sugar-making machinery, consisting primarily of the following appliances: Triple effect, 25,000 gallons; improved system of Deming clarification, four settling tanks, 500 gallons capacity each; two lining tanks, one 10-ton vacuum pan of the Deecy type, having a 20-inch gate operated from a wheel or working platform, the sugar dropping direct to 30-inch centrifugals, five in number, three for No. 1 sugar and two for graded sugar, forty cooler cars, all running on tracks so that they can be so transferred as to empty into mixers.

From here the sugar passes into the sugar house to be loaded on tramway or cars, as elected, and conveyed to warehouse at landing. The mill is supplied with an improved Corliss engine of 125 horsepower fitted with the latest oiling system.

The method of transporting cane from field to mill is by V flumes and aerial rope-